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A review of the spatial economics of non-timber forest product extraction: Implications for policy

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ABSTRACT

Patterns of forest cover and forest degradation determine the size and types of ecosystem services forests provide. Particularly in low-income countries, nontimber forest product (NTFP) extraction by rural people, which provides important resources and income to the rural poor, contributes to the level and pattern of forest degradation. Although recent policy, particularly in Africa, emphasizes forest degradation, relatively little research describes the spatial aspects of NTFP collection that lead to spatial degradation patterns. This paper reviews both the spatial empirical work on NTFP extraction and related forest degradation patterns, and spatial models of behavior of rural people who extract NTFPs from forest. Despite the impact of rural people's behavior on resulting quantities and patterns of forest resources, spatial–temporal models/patterns rarely inform park siting and sizing decisions, econometric assessments of park effectiveness, development projects to support conservation, or REDD protocols. Using the literature review as a lens, we discuss the models' implications for these policies with particular emphasis on effective conservation spending and leakage.

1. Introduction

A growing literature documents the importance of non-timber forest products (NTFPs) to the livelihoods of many rural households in low-income countries. Though the extraction of non-timber forest products supports rural livelihoods, that activity also causes spatial patterns of forest degradation. Both the amount and pattern of forest quality contributes to the forest's provision of biodiversity, carbon storage, and other ecosystem services. Policies to slow or prevent forest degradation often include a combination of explicitly spatial policies such as parks and buffer zones, and non-spatial policies such as poverty alleviation projects or payment for environmental services (PES) such as REDD. The success or failure of such policies in low-income countries depends on the reaction of forest resource users as to which forest products they collect, how much, how intensively, and from which locations in which forests (Wells, 2003; White and Martin, 2002). Still, relatively little of the literature on NTFPs explicitly considers the spatial decisions of NTFP extractors nor the spatial outcomes of policies to prevent forest degradation.

The ecological, economics, and reserve site selection literatures on park siting and sizing (such as Costello and Polasky, 2004; Margules et al., 1988; Pressey et al., 1993) rarely consider that the reaction of rural people to the siting and management decisions may lead to a smaller effectively protected area or to degraded areas within the park because illegal activities continue. Similarly, the recent econometric analyses of park effectiveness at preventing deforestation also fail to consider a spatial model of the deforester's decisions as a function of park management activities (e.g. Andam et al., 2008). That omission implies that such frameworks cannot assess the amount and location of degradation and deforestation that arises from leakage – the displacement of these activities into unprotected or less protected areas of forest – which undermines the net impact of parks. Leakage presents particularly important for nascent REDD (reduced emissions from deforestation and forest degradation) policies because any leakage offsets the global benefits associated with lower deforestation and degradation in the particular area where

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REDD is implemented (Angelsen, 2008). Because people react to policy by altering the amount and location of their forest degrading activities thereby creating the pattern of forest quality, ignoring that spatial reaction to park siting, management, evaluation, and REDD decisions hampers the effectiveness of those policies and evaluations.

To provide context, in the next section this paper briefly discusses the main themes in the non-spatial economics literature on NTFPs. Then, the paper reviews more recent advances in the literature that take into account spatial aspects of NTFP extraction, patterns of degradation, and related policies. In that review, we highlight both the role of the market setting, including distance to markets, and the importance of costs associated with distances to extraction locations. Using the literature review as a lens, Section 4 discusses how insights and results from the spatial NTFP literature can inform park siting and sizing decisions, econometric assessments of park effectiveness, development projects to support conservation, and REDD protocols. A final section concludes.

2. Non-spatial Economics Literature on NTFPs

Forests provide subsistence products and income to an estimated 1.6 billion rural people in developing countries (World Bank, 2004). In this section we address the literature that focuses on the contribution of non-timber forest products to livelihoods, as a safety net, and the importance of markets.

2.1. The Contribution of NTFPs to Livelihoods

Much of the earlier economics literature on NTFP extraction emphasizes the value of those products to rural households, focusing on the quantity of resources extracted and how dependence on common land resources varies with household wealth (Adhikari, 2003; Bahuguna, 2000; Cavendish, 2000; de Beer and McDermott, 1989; Fearnside, 1989; Ganesan, 1993; Gunatilake et al., 1993; Jodha, 1986, 1992; Mahapatra et al., 2005; Poulsen, 1990; Reddy and Chakravarty, 1999). These papers typically rely on cross-sectional data and measure what and how much is collected, rather than extraction locations and the time and distance costs involved (Robinson and Kajembe, 2009). Often the papers focus on one particular forested area within a country. In contrast, Vedeld et al. (2007) performs a meta-analysis of 51 case studies to determine the level of dependence or rural people on income from forests. Their results find that fuelwood, foods, and fodder constitute the bulk of the value drawn from forests and provide households with over a fifth of their total income. The specific case studies vary in the location and their findings. But whether based on data from Africa, Asia, or South America, key findings include: significant contributions of forest-related income generated by rural households; poorest households tend to rely on NTFP extraction for a large fraction of their effective income; and wealthier rural people, though less dependent, often use large quantities of forest resources.

2.2. NTFPs as Safety Nets

Less attention has been paid in the literature to the role of NTFPs as safety nets, or in risk management: helping rural households to avoid poverty; and to smooth their overall consumption by supplementing incomes during lean agricultural seasons (Angelsen et al., 2001; Baland and Francois, 2005; Fisher and Shively, 2005; Pattanayak and Sills, 2001). Several papers highlight the link between deforestation/permanent clearing for agriculture, and the loss of forests as a safety net (Delacote, 2007; Sunderling et al., 2004). Delacote (2007) explores the land use allocation decision between forest and agriculture when households have an incentive to maintain forests as a safety net for NTFP extraction in bad times. If forests provide relatively large quantities of NTFPs then less forest land is needed for "insurance" and agricultural land is expanded. Though the paper is not explicitly spatial, the expansion of agricultural land into the forest changes the distances of villagers from their homes to the forest resources and this in turn changes the relative returns to agriculture and NTFP extraction.

Linkages between shifting cultivation systems and NTFPs as a safety net are made by Jakobsen (2006). Shifting cultivation systems are spatially and temporally complex and within these systems NTFPs provide different benefits across different seasons; at different times in a cycle; and during the transition out of shifting cultivation. Jakobsen, although not using an explicitly spatial lens, finds that as agriculture transforms from a shifting cultivation system to permanent settlement, NTFP collection, though it becomes more commercially oriented, still remains a safety net, though often an economic rather a than subsistence one.

2.3. Agricultural Household Models with Market Setting and Property Rights

Agricultural household models form the basic modeling structure for analyses of labor allocation decisions within rural households in low-income countries (Singh et al., 1986). Many NTFP extraction models use a household model with some labor allocated to NTFP extraction. With complete markets, household production and consumption decisions (for NTFPs and other products) are separable but, as Sills and Abt (2003) recognize explicitly, households at forest margins face incomplete markets, and so over some range of parameters households neither buy nor sell NTFPS but collect for home use. In such circumstances where markets are missing or incomplete, consumption and production decisions are linked.

Some NTFP household models assume a market setting, some explore a range of settings, and other endogenously determine the market setting. Similarly, whether villagers collect NTFPs for their own use or for commercial sale depends on market access or on modeling assumptions. NTFP extraction may occur illegally in parks or forest reserves and measures taken to enforce those property rights also inform the household NTFP extraction decisions. Overall, agricultural household models provide a powerful tool for examining NTFP extraction. The market setting for resources and labor in addition to property rights regimes contribute to the extraction decisions, which implies that policy results from models depend on the market setting.

Amacher, Hyde, and Joshee (1993) construct an agricultural household model with jointness in the production and consumption decisions about fuelwood extraction and in the presence of complete labor and resource markets. Using household data for Nepal, they then perform regressions to identify the role of community forests and trees on private land on the demand for, and labor allocations decisions, for fuelwood. They find that time is a large component of fuelwood production, that women and children collect relatively more fuelwood in community forests while men perform more fuelwood collection from private land, and that the relative abundance of forest inventory contributes to fuelwood extraction decisions. Similarly, Amacher, Hyde and Kanel (1996) rely on a household model to address fuelwood demand, but in this paper the authors focus on how villagers change their demand for fuelwood in response to changes in forest policy. As such this paper can be considered a precursor to many of the spatial papers by Albers, Robinson, and their coauthors, that we review later in this paper. The authors include in their econometric analysis distances to trails, roads, and villages, though not to markets or specific forests, but these distance parameters turn out not to be significant.

A household model is also central to Bluffstone (1995) who develops a dynamic model of an open access forest comparing perfect and absent labor markets. Deforestation is represented by a "state of the forests" parameter. In this model, with labor markets there is a stable forest but without the forest is unstable. Again, there is no